IoT Based Digital Weight Scale in Rice Inventory for Small and Medium Entreprises

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ABSTRACT

In the current digital era, Internet of Things (IoT) technology offers innovative solutions to increase efficiency and accuracy in various sectors, including the rice sales business. This journal discusses the design of IoT-based scales specifically designed to help with bookkeeping in rice sales businesses. The main objective of this research is to develop a weighing system that can automatically measure the weight of rice and integrate it with a digital bookkeeping system, thereby minimizing manual errors and increasing operational efficiency. The research methodology includes design of weighing hardware and software, implementation of weight sensors, and development of IoT applications that connect scales with bookkeeping systems. The system is designed to send real-time weight data to a cloud-based bookkeeping platform, enabling more accurate and faster monitoring and reporting. Test results show that this IoT-based scale can provide weight data with high accuracy and seamless integration with the bookkeeping system. Users report increased efficiency in the process of recording and managing rice sales data. In conclusion, IoT-based scales offer an effective solution for modernizing the bookkeeping process in rice sales businesses, supporting better decision making and improving the accuracy of financial reports.

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1. INTRODUCTION

Rice sales business is one of the important business sectors in Indonesia. Rice is a basic need that is always needed by the community [1]. However, rice stock management, recording sales transactions, and monitoring inventory are still often done manually, which can result in inaccurate data and inefficiency in managing sales businesses. Therefore, it is necessary to adopt information technology and an integrated management system to improve operational efficiency, reduce errors, and provide accurate and real-time data for better decision making [2]-[4]. The company produces high-quality products that will provide benefits compared to producing low-quality products. This means that customers will be willing to buy an item at a reasonable/relatively affordable price, with good quality goods. Price has a direct influence on the selection of a store, customers will also always consider the price factor in marketing it in the long term and to make a profit [5]. In addition, high-quality products produced by the company can also increase customer loyalty, brand reputation, and competitiveness in the market, so that the company can maintain a strong position and grow in the long term [6]-[8].

Microcontroller components can now be applied to almost all equipment with a control system [9]. Control applications allow the creation of devices that support human performance more practically or as more efficient work tools, which can be beneficial for human life and in the industrial sector [10]-[12]. In the digital era, the application of Internet of Things (IoT) technology can provide a more efficient solution in this regard [13]-[15]. With IoT, various devices can be connected and communicate with each other, enabling more sophisticated automation and remote control. This not only improves operational efficiency but also enables real-time data-based decision making, which in turn can increase productivity and reduce operational costs [16].

IoT-Based Scales are tools that allow measuring the weight or mass of goods by connecting to the internet network [17]. The use of IoT in scales allows rice sales business owners to monitor rice stock in real time, record sales transactions, and obtain accurate information about inventory. Thus, rice sales business management can be more efficient and responsive to changes in market needs [18]-[19]. The problem of measuring the weight of rice which is often inaccurate and requires a lot of time and energy, prompted the author to develop an innovative solution in the form of an Internet of Things (IoT)-based scale. In this final assignment, the author uses an Arduino Nano microcontroller and an additional Nodemcu ESP32 microcontroller. Both of these microcontrollers can be directly connected to the internet network (Wi-Fi) without requiring additional components. This system utilizes a loadcell sensor as input to measure the weight of rice, while the output will be displayed in the form of a spreadsheet that not only displays the weight of rice, but also the price of rice in real time. This development is expected to provide a more efficient and accurate solution in measuring and monitoring the weight and price of rice.

2. METHOD

This research has several stages in the manufacturing process, starting from the manufacture of hardware as a component framework and programming on the Arduino Nano microcontroller and the ESP8266 microcontroller as a media for connecting to the internet. Block diagrams are important in designing a tool to make it easier to manufacture the tool. The following is a block diagram of the tool and material design in Figure 1.

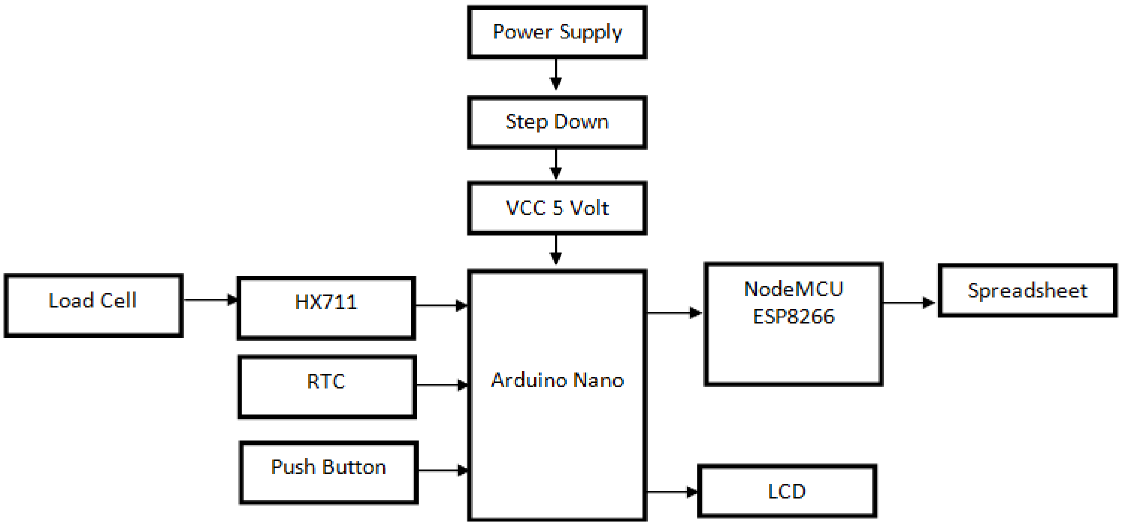

Figure 1. Diagram block of proposed digital weight scale

The system block diagram in Figure 1 illustrates the system structure consisting of several components with different functions. Arduino Nano functions as the control center and control of the components used, NodeMcu 8266 this module will be an intermediary so that the measurement and calculation data carried out by Arduino nano will be sent to Google Spreadsheet. HX711 is a driver for processing data from the load cell into analog data so that it can be read by Arduino Nano. Load cell functions to read and convert the weight of the load into electrical energy. The power source on this tool is a 12 volt power supply. Step down functions to lower the voltage from the power supply. The push button on the diagram functions to select or set the type of rice being measured so that the microcontroller can calculate the price of rice according to the type of rice selected using this push button. RTC (Real Time Clock) is a time module where this module is used to read hours, days and dates. LCD (Liquid Crystal Display) module that functions to display weight measurement data and calculation costs of rice prices. Spreadsheet is a platform that contains tables and columns that function to store, manage and analyze data. In this case, the recording/bookkeeping of rice sales is used. Figure 2 shows the circuit schematic and mechanical design for a digital weighing scale with details of the relationships between the components used in the system..

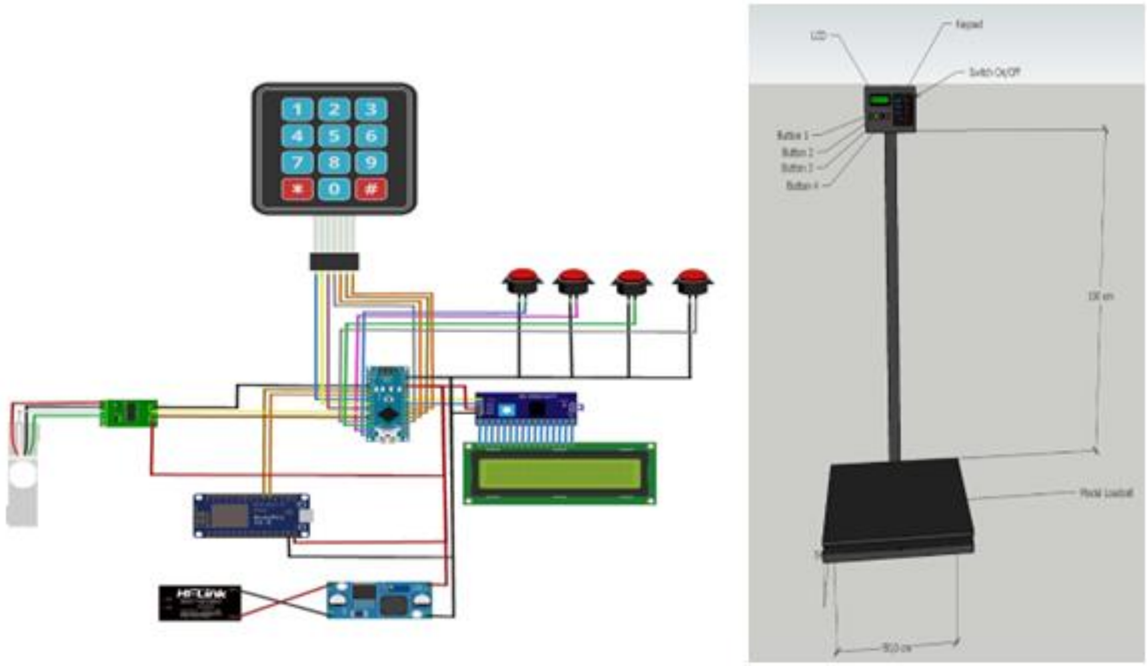

Figure 2. Hardware design of digital weight scale

Figure 3 provides a detailed explanation of the system workflow with a flowchart as a visual representation. Flowcharts help analysts and programmers to break down problems into smaller segments. Start 88 means the beginning of the flowchart, initialization Input output, namely declaring which is the input and output on the device. Reading the type of rice button that is pressed, the pressed button determines the type of rice to be weighed and determines the selling price of the rice. Reading the measurement results from the loadcell of the measured rice, then calculating the selling price using the formula Selling price = Rice Price x Rice Weight. After weighing, the button is pressed to send the measurement results and the selling price of the rice to the Google spreadsheet. The measurement results and selling price will appear on the LCD

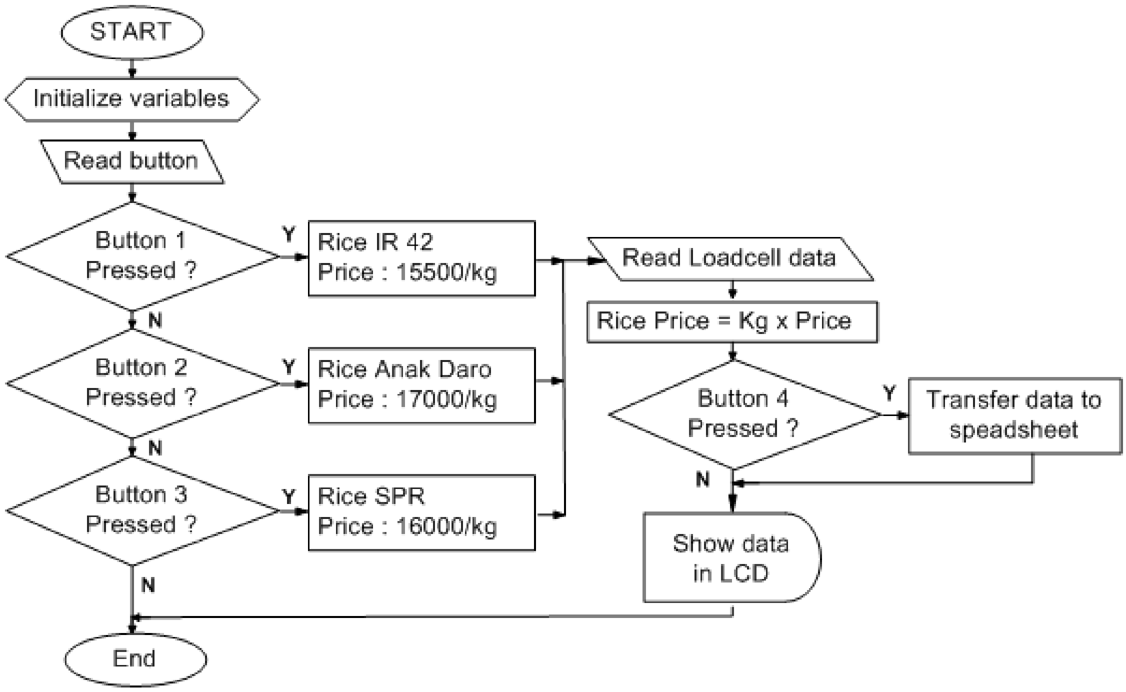

Figure 3. Flowchart of digital weight scale

3. RESULTS AND DISCUSSION

The IoT-based digital rice weighing scale proposed in this paper is tested with weights that have varying weights, starting from 10 kg, 20 kg and 30 kg. The results of the tool readings are compared with rice weight measurements with analog weighing scales. Figure 4 shows the process of testing the rice weighing scale made in this study.

Figure 4. Experimental process of digital weight scale

Table 1 describes the results of testing digital weighing scales and their comparison with analog weighing scales with various types of rice weights. The measurement results in Table 1 show that the measurement data obtained from the proposed digital weighing scale are in accordance with the measurement results of the analog weighing scale with an error of 0%. The same results were obtained for all experiments. This shows that the proposed digital weighing scale has provided valid results and can be used to measure the weight of rice. One of the superior features offered by this digital weighing scale is the availability of rice price data and selling prices according to the weight of the rice, so it is more effective and efficient to use. These results also show that the IoT-based digital rice weighing scale created in this study is suitable for use for Rice Inventory, both for small and medium scales.

Table 1. The Experimental results

Rice weight	Analog scale	Digital scale
10	10	10
20	20	20
30	30	30

Next, the validity of the load cell reading was tested based on the position of the rice on the scale. The test was carried out at five positions, as shown in Figure 5. The test was carried out using 10 kg of rice. The test was conducted by varying the position and condition of the rice. The rice was positioned in a lying or standing position which was placed in the middle or edge of the scale, as shown in Figure 5.

Figure 5. Second experimental process of digital weight scale

The results of all tests show that the data reading by the load cell remains the same 10 kg according to the weight of the rice, even though the position of the rice is varied in various places. This shows that the proposed digital rice weighing scale has provided valid results and is suitable for use. The test results of all experiments are shown in Figure 6, where the error in reading the load cell data is 0% for all measurements.

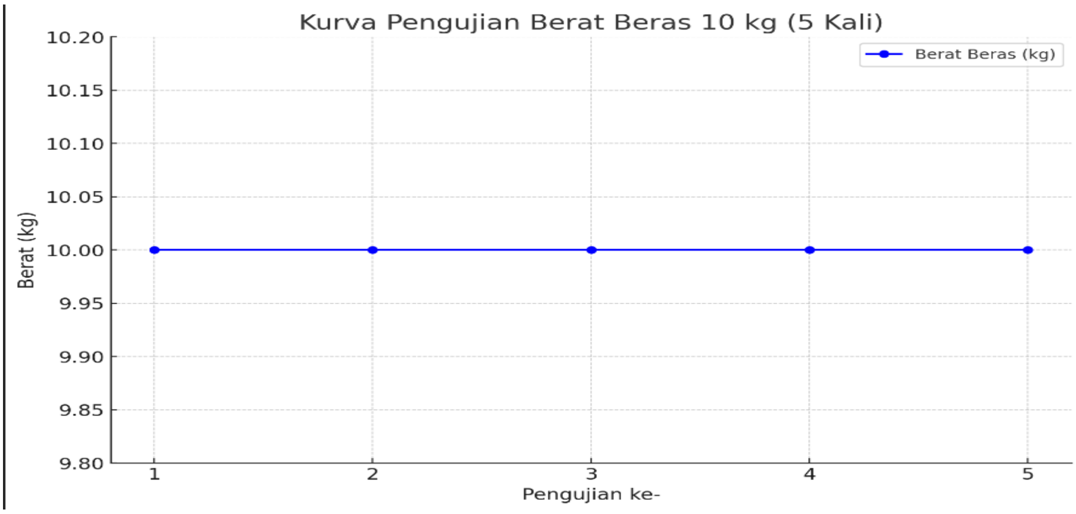

Figure 5. Results of a Second experimental

4. CONCLUSION

This paper proposes a digital weighing device for small and medium-scale rice sales. This device uses Loadcell as a weight sensor controlled by Arduino and then displayed on the LCD for measurement results and google spread sheet as a transaction record on this device. Measurement results and rice sales can be monitored in real-time using google spread sheet. The test results show that the device has successfully weighed rice according to its real value and has also successfully displayed data on the LCD and recorded rice sales on google spread sheet. This makes rice sales more efficient and effective.

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